**PCA – Factor Model**

What is Principle Component Analysis (PCA)

Consider a sample matrix which means we have n features and m data sample

The features of matrix :  
(1)  
(2)

The definition of PCA:

The PC loadings () and PC Value () is defined as the following

1. I th row of are the I th PC loadings vector and the norm of it is 1
2. I th column of are the PC value vector of I th data point
3. j th row of are the j th PC value for each data point

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Each PC loading is an eigenvector of   
 is orthogonal matrix

PCA Application : Factor Model

Suppose we have n asset return and m data sample for each asset

The Sample Matrix () are in dimension (n x m) with the features :

Step 1 : Standardized the Sample

Step 2 : PCA

Suppose we manage to apply dimension reduction and only use first p PCs

Then PC Value () and PC Loadings () could be viewed as the following:

Where

Step 3 : Factor Model

Where  
risk factor return , beta exposure , noise